

2000 SouthWest Test Workshop

*"A Method for Probing...
Multiple Four Sided, Fine
Pitch, Small Pad Devices
... using Cantilever Probes"*

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Multi-Site Probing Session



Overview

- Why the need & why now
- Present day approaches
 - *Pros/Cons*
- A different approach
- Design and characterization results
 - *Comparisons of “in-line” vs. “diagonal” approaches*
- Moving forward . . . design considerations
- Manufacturing overview
- Review and next step
- Questions



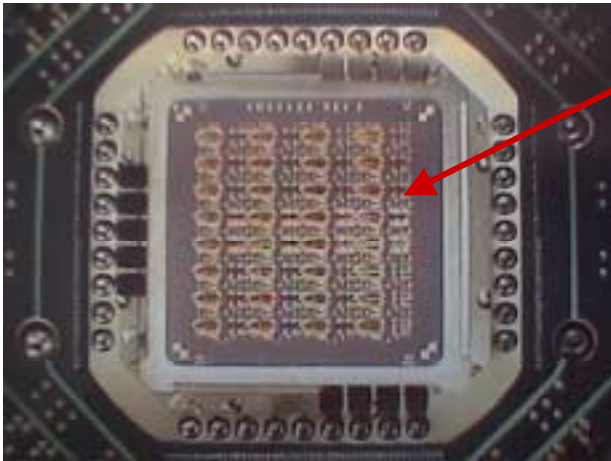
Why the Need

- As with memory; especially DRAM:
 - *Need to reduce test times & cost*
 - *Higher throughput*
 - *Increased life expectancy of probing solution(s)*
 - *More “Touched Die” per card*
- **Why NOW ???**
 - *More advanced testers and probers*
 - *Speed*
 - *Resource availability*
 - *Look-up cameras*

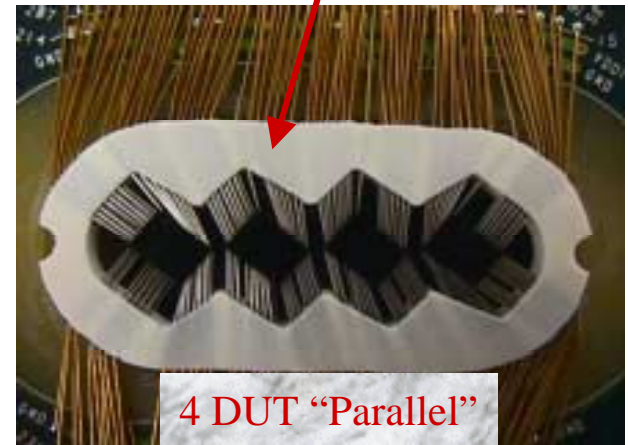


Present Day Approaches

Vertical Solutions



Cantilever Solutions (AKA: Epoxy Ring)



Present Day Approaches

Pros / Cons

	Cost	Delivery	Performance
Vertical Solutions	Med - High	4 - 16 wks	Med - High
Cantilever Solutions	Low - Med	2 - 4 wks	Low - Med

Problem Statement:

- *Primary disadvantage of cantilever is inconsistency of beam lengths*
 - *Resulting in force and scrub variations*
 - *Potential issues on smaller pads; ie: Pad Damage*



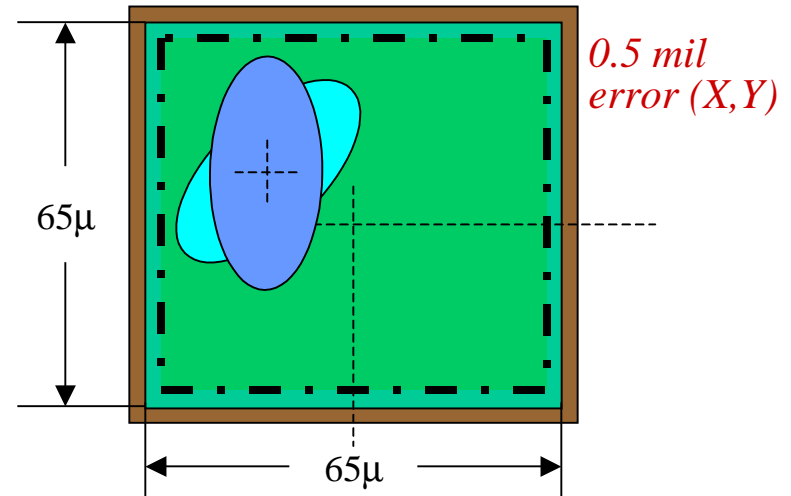
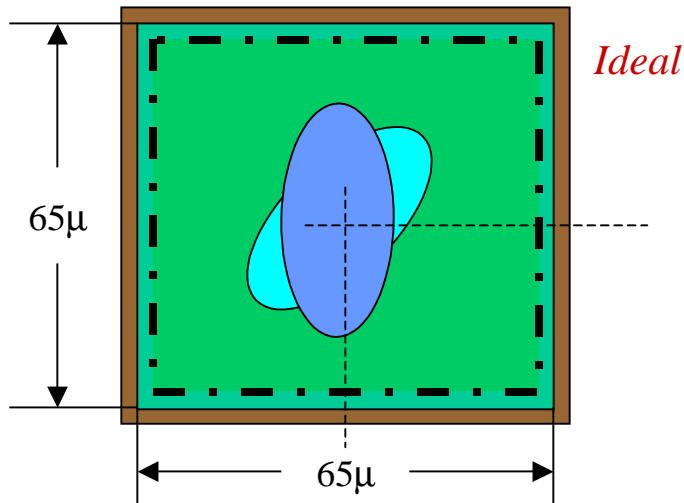
A Different Approach

- Goals:
 - ▶ **Improve cantilever approach**, so **Force and Scrub** are better controlled, while improving opportunities for probe placement.
- Requirements:
 - ▶ Tighten accuracy requirements to ± 0.3 mil max
 - ▶ Reduce probing angle to $<10^\circ$
 - ▶ Maintain consistency in beam lengths

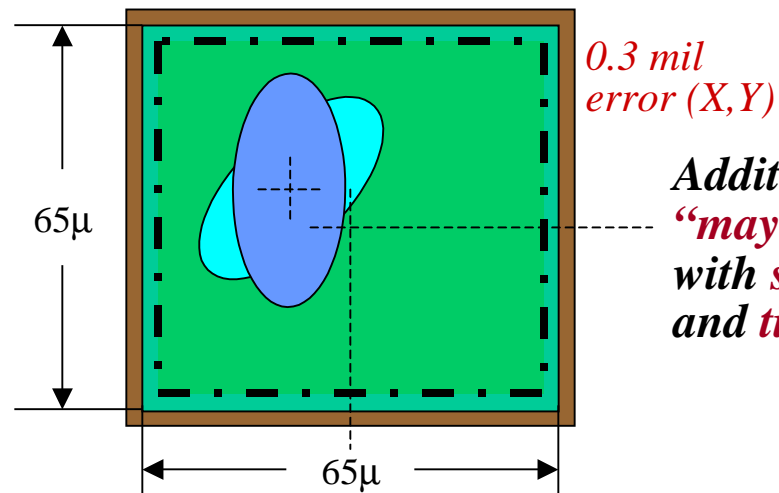


A Different Approach

Address Accuracy and Probe Angle



- *Example shown is with:*
 - ▶ 1.0 mil Tip
 - ▶ Yielding a 1.5 mil total scrub

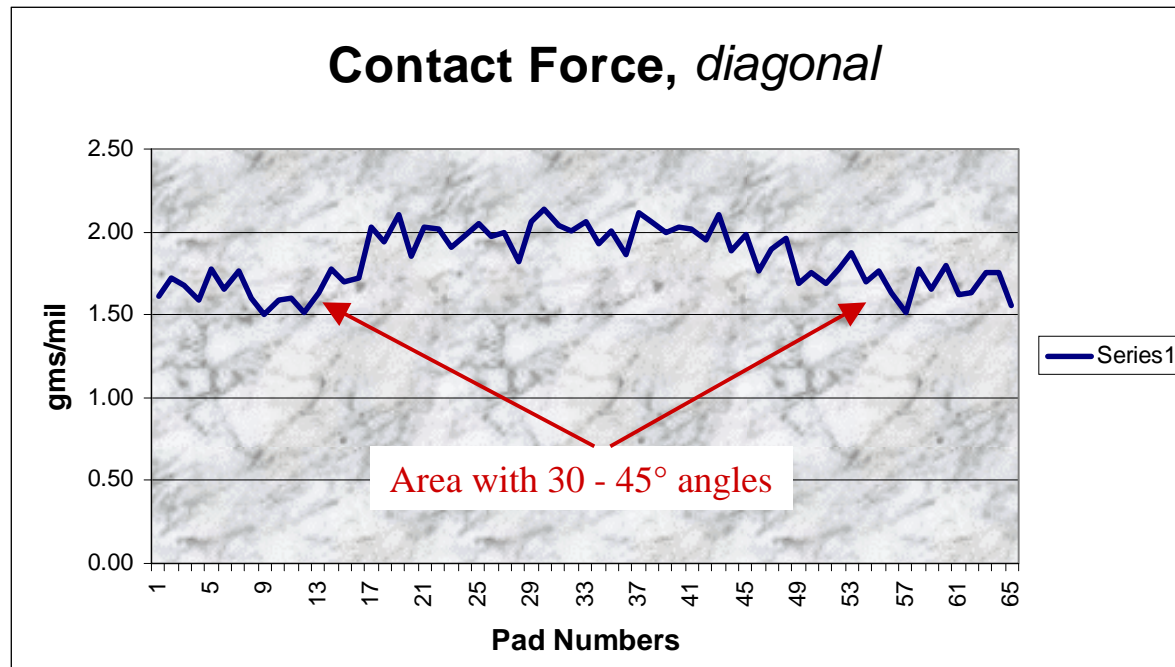


Additional improvements “may” be accomplished with smaller tip diameters and tighter specs

A Different Approach

Address Probe Force Consistency

- Typical Force Distribution for Today's Cantilever Solutions:



Goal: 2 gms/mil

Variation: 30%

Std Dev: 0.18

A Different Approach

- A Better Way:



4 DUT Solutions

Design Criteria

- Test die specifications
 - ▶ *0.200 X 0.200*
 - ▶ *120 pads/die peripheral*
 - ▶ *Pad size: 65 μ*
 - ▶ *Pitch: 77 μ*
- Ring design specifications: *(1 x 4; 2 x 2)*
 - ▶ *9 and 11 layers*
 - ▶ *6 mil wire*
 - ▶ *37 and 41 mil maximum tip lengths*
 - *Targeted:*
 - ▶ *1.5 gms/mil*
 - ▶ *0.6 mil tip diameter*



Design Approach

- A Better Way:
 - ▶▶ *Consistent beam lengths, ALL sides of ALL die*
 - ▶▶ *Results in contact force distribution <10%*
 - ▶▶ *Results in better control of scrub*

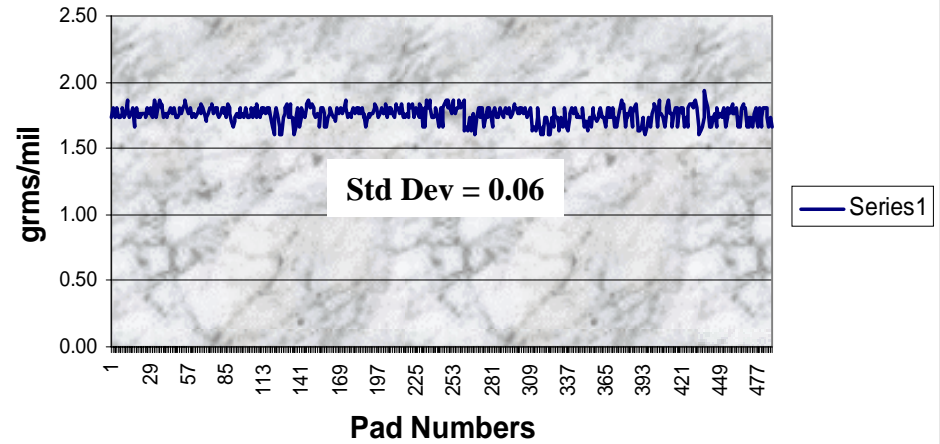


Characterization Data

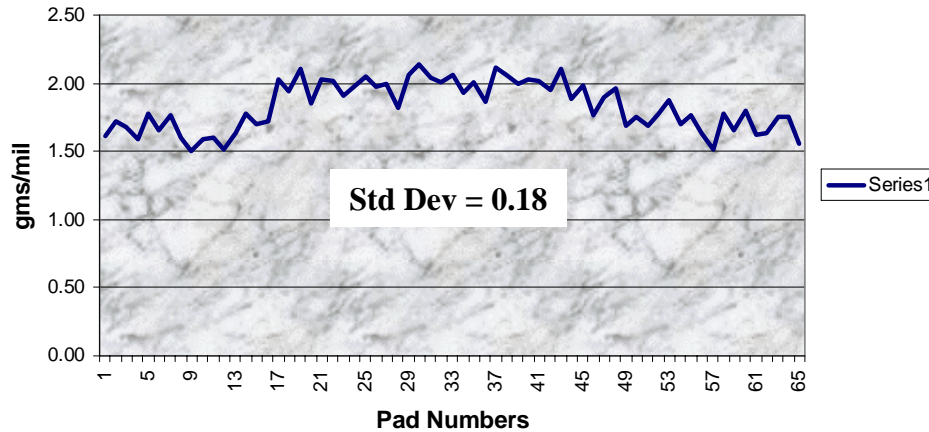
10% Variation



Contact Force, *in-line*



Contact Force, *diagonal*



30% Variation

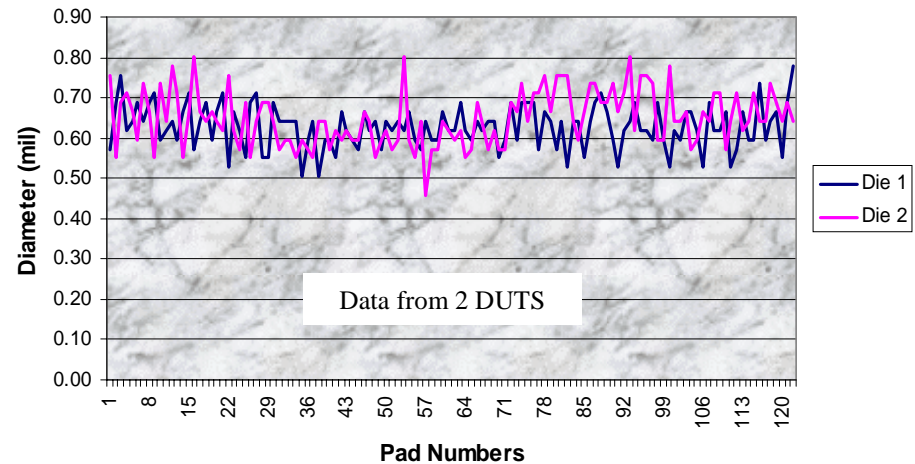


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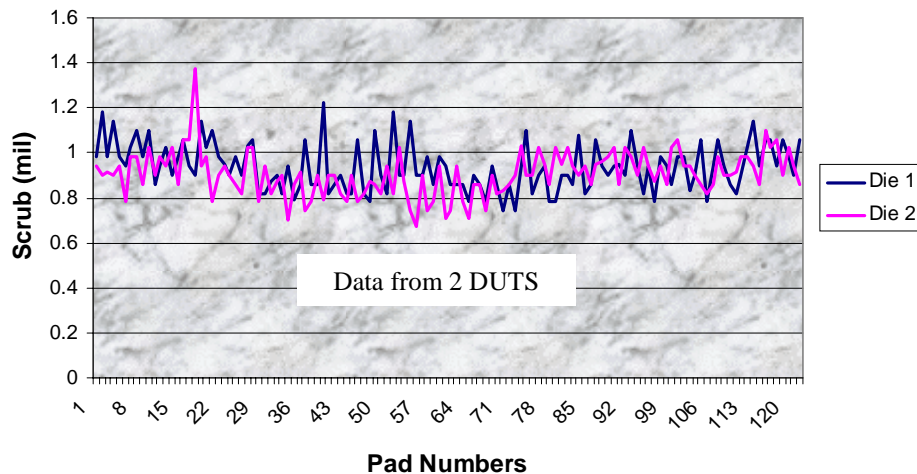
Characterization Data

- **Results show consistency . . .**
 - ▶ *Within and between die*
 - ▶ *From layer to layer (9 layers)*

Tip Diameter, *in-line*



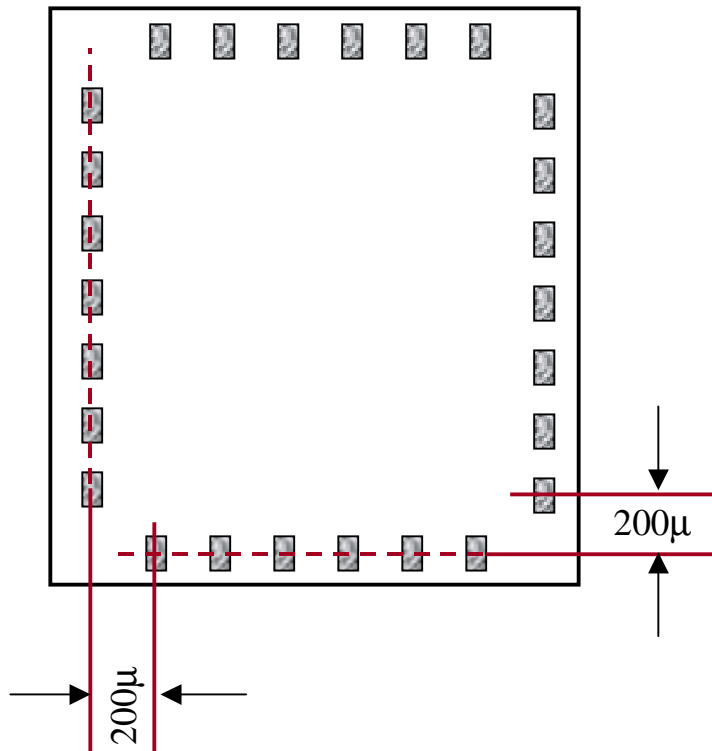
Scrub Lengths, *in-line*



- **Data taken from an Al wafer at:**
3mil overdrive
- **Measured on a:**
RAM Optical Measurement System



Moving Forward Design Considerations



- **Design for manufacturability specifications:**

- ▶▶ *Center to center spacing from columns to row = 200µ minimum*

- ▶▶ *For ALL four sides of the die*

- ▶▶ *Minimum pad size = 60*

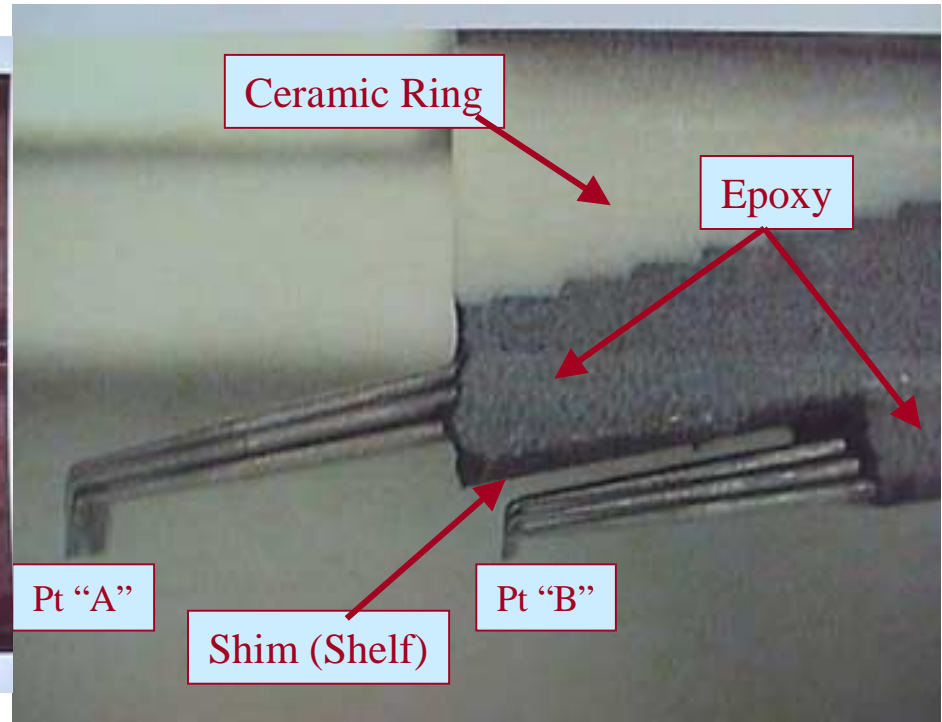
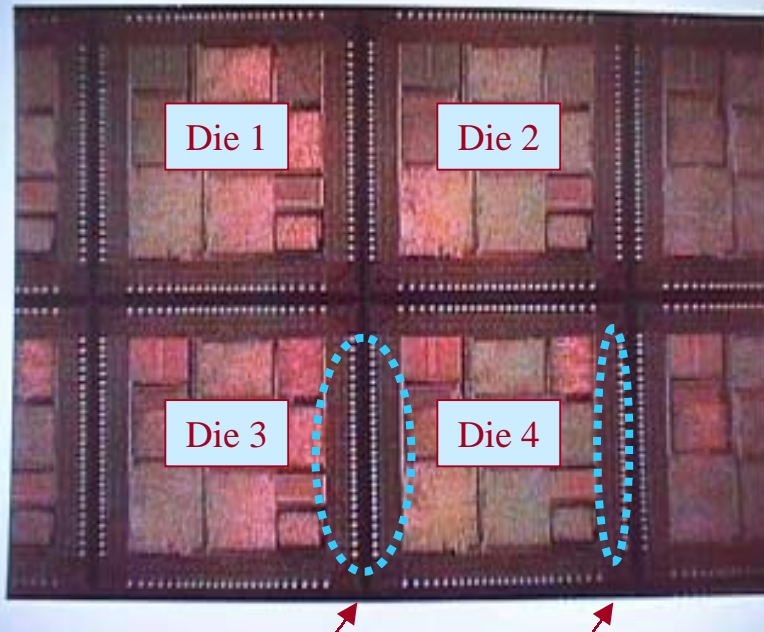
- ▶▶ *Minimum pitch = 70*

- ▶▶ *Various exceptions and conditions always need to be reviewed and considered*



Manufacturing Overview

2 X 2 Approach



- Process is an extension of existing cantilever approaches used in other applications, such as: Multi-Dut DRAM
- Specialized tooling required for alignment and repair of such approaches


Review and Next Step

- Multiple technologies can probe:
“Multiple four sided, fine pitch, small pad devices”
- ***Cantilever*** has been capable in the past.
*With a low cost and quick turn time solution.
Yet with variations in it’s results.*
- ***Cantilever solutions*** can now be manufactured to yield the desired consistency !!!
- ***Better utilization*** of prober and reduction in number of touchdowns (**In-Line vs. Diagonal**)
 - *Less potential “touch-offs” or “double touches” as compared to a diagonal approach*
 - ▶ *For the example given: 288 TD vs 300 TD*
of the 1100 potential die



Review and Next Step

- Appropriate “systems” are required to utilize these solutions
 - *Prober Capability: Look-up Cameras*
 - *Repair Capability: Inverted Alignment Systems*

- 1x4 and 2x2  2x4 *and beyond . . .*



?? Questions ???

